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Agricultural Memorandum No. 404

Gramineae Pollen in London - A Meteorological Model

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In an attempt to link the daily pollen catch in London with current weather the following model was constructed. Basic calculations were carried out in terms of pollen units, these being the mean daily counts divided by the seasonal total in thousands. The aim was to find a composite meteorological parameter which could most closely approximate to these daily units.

The following factors were considered:

(a) Release pattern (discussed in Ag. Mem. 380a) - assumed to conform to a curve showing a rapid rise 0 - 10%, a circular segment from 10% to 60% and a linear decrease thereafter; the percentages refer to the pollen previously released expressed as a percentage of the seasonal total. It was found convenient to combine this with a temperature factor.

(b) Temperature effect The minimum day maximum for release appeared to be 14°C. In June there was an increase of pollen units amounting to about 4 per degree C above a box of 13°C. In July this was reduced to about 2. Maxima over 26°C appeared to have little further increasing effect. To combine this with the release pattern, a temperature factor was chosen dependent on the percentage of pollen released to date, as follows:

(i) With 1 per cent released, the factor was 1.3, increasing by 0.3 for every further per cent up to a value of 4.0 at 10 per cent release.

(ii) Between 10 and 35 per cent, the factor was increased by 0.1 for every 2 per cent increase in release; between 35 and 60 per cent it was then decreased at a similar rate, again reaching 4.0 at 60 per cent, having attained a maximum of 5.2 at 35 per cent.

(iii) Between 60 and 80 per cent this factor was reduced by 0.1 for every 1 per cent decrease to a value of 2.0 at 80 per cent and remaining at this value thereafter.

The temperature contribution to the meteorological parameter was then found by multiplying this factor by the excess of the day maximum over 13°C (with a limit of 13).

This method successfully combined the release pattern with the temperature effect until early July when the 80% release state was normally reached. To allow for the further decrease in pollen release a deduction of $\frac{1}{2}$ was made for every day after July 1st.

(c) Sunshine Effect The meteorological parameter was decreased by 1 for every hour of bright sunshine below 10; no allowance was made for higher sunshine values. This deduction was halved in July.

(d) Wind speed Effect The meteorological parameter was increased by 1 for every knot in the midday wind speed below 9, and decreased by 1 for every knot above 9. This correction was halved in July.

(e) Wind direction Effect The parameter thus obtained from day maximum sunshine and wind speed was then corrected for direction as follows:

SW	- no correction
NW	add 10 per cent
NE	subtract 40 per cent
SE	subtract 25 per cent
Variable	subtract 20 per cent

(f) Convection Effect On days when convection was present, as detected by the presence of large cumulus or cumulonimbus clouds the parameter was reduced by 10 per cent.

(g) Day Rain Effect On days when 2 mm of rain fell during the day the parameter was finally halved.

Thus if T is the temperature factor
M the day maximum air temperature
S the sunshine hours
W the midday wind in knots
D the wind direction factor
C the convection factor (1 or 0.9)
R the rain factor (1 or 0.5)
then the meteorological parameter in June is

$$\left[T\,(M-13) - (10 - S) - (W - 9)\right] DCR$$

with M-13 having a maximum of 13
10-S having a minimum of 0
W-9 having a maximum of 9

In July this becomes

$$\left[T\,(M-13) - \frac{10-S}{2} - \frac{W-9}{2} - \frac{d-1}{2}\right] DCR$$

where d is the date in July

This parameter was then multiplied by the seasonal total in thousands to convert estimated pollen units into estimated pollen counts.

Two further restrictions had to be applied, at the beginning and at the end. The "start" of pollen release had already been defined in terms of the first day on which a count of 50 has been observed. This had been related to April and May temperatures and varied from June 4th to June 9th. It was therefore reasonable to impose a maximum of 40 prior to these dates. Towards the end of the season, pollen supplies would have been exhausted, no matter what the weather was. A maximum of 80 was therefore imposed when total release had reached 90 - 95%, and a maximum of 40 thereafter.

Closeness of fit Using this parameter, the estimates were such that the following percentage distribution of errors resulted:

	June	July	Total
Correct	15	27	21
Within 10	33	53	43
Within 20	51	70	61
Within 30	63	79	71
Within 40	72	87	80
Within 50	77 per cent	92 per cent	85 per cent

If three categories are chosen 0 - 50 low
50 - 150 medium
150 or more - high

and allowing a figure on a boundary (50 or 150) to lie in the favourable category, correct categories were obtained

on 246 occasions in June (82%)
and 260 occasions in July (84%)

Of the remainder, near-misses were allowed if a figure lay within 10 of a boundary or if the estimate and observed catch differed by 50 or less. Near misses were then:

6% in June and
10% in July

leaving major errors as

35 occasions in 10 years in June (12%)
and 18 occasions in 10 years in July (6%)

Taking into account the sampling errors involved, both in catch and meteorological observations, this standard of result can be considered satisfactory.

Any comments or suggestions on this paper should be referred to the Author.

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Bracknell, Berks.

August 1971

G 13554/LL/8/71/40 (3)